Storage of Rice. VII.

On the Influence of Varying Moisture Content and Germinating Power upon the Preservation of Vitamin-B in Hulled Rice.

By

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Introduction.

Akimoto[3), 4)] (1930, 1931) reported that, if rice is not dried sufficiently, which is often the case when the harvest-time is very wet, its vitamin-B will be easily decomposed. He concluded further that people who eat rice of a rainy harvest are likely to contract beri-beri. The present authors, with high regard for Akimoto's opinions in their bearing on problems of nutrition of the people and storage of rice, presented him with several samples of rice of different moisture content for further studies of the relation between moisture and vitamin-B content. The rice had been stored by the authors at the Ōhara-Institute for four years in air-tight containers. Akimoto found that the rice with a moisture content of 10%, which had been stored four years, was equal to new rice in regard to content of vitamin-B. The present authors[1)] (1930) already had reported practically the same results and that hulled rice retains its vitamin-B perfectly for four years, if dried to a moisture content of 11.5% and stored air-tight or in CO_2.

Since then the authors have studied further the influence of various degrees of moisture upon the preservation of vitamin-B in hulled rice stored at the Ōhara Institute.

At the same time the authors take this opportunity to report on an experiment concerning the germinating power and its relation to the preservation of vitamin-B in hulled rice, which was carried out in 1929.

I. Influence of Varying Moisture Content on the Preservation of Vitamin-B in Hulled Rice.

1. *Material.*

The variety of rice used in this experiment was "Shinriki". It was harvested in November 1930, dried in the sun-light and hulled in January 1931. The mois-

ture content of the samples was respectively 10.2%, 11.7%, 14.1%, 16.1% and 18.3%. The rice was stored from January to May air-tight in a zinc container. During that period the rice only once, and then but a short time, reached the temperature of 30°C. In June it was transferred to straw bags and stored until August when it was used for an experiment on vitamin-B. During storage in straw bags, the rice absorbed moisture from the atmosphere and the moisture content became respectively 12.6%, 13.4%, 14.7%, 16.0% and 16.1%. The germinating power of rice in August 1930 was as follows:

Moisture content of hulled rice	Germinating power
12.6%	59.0%
13.4%	49.5%
14.7%	21.5%
16.0%	7.0%
16.1%	0.0%

As above stated, the rice varied in moisture content and was stored five months (only once, and then for a short time, reaching 30°C) air-tight and then three months in straw bags in the granary of the Institute. The results show that the rice varied in germinating power from 0.0% to 59.0% dependent on the moisture content.

2. *Method.*

As experimental animals young white Leghorn fowls were used. One week before the experiment the fowls were fed with new hulled rice as usual and then during the experiment 50% of the hulled rice was added to white rice. Of this food 10 g. per Kg. of body weight per day was fed. A small quantity of Osborne salts, casein and cod liver oil were added to the food. Three fowls were used as a set for each kind of rice. Latent period of beri-beri illness and living days from the beginning of the feeding experiment until death were determined. Employing the formulas of Ogata[5] and Moahi[6] the comparative values of vitamin-B content in the samples of rice with the different moisture content were calculated. Weights of fowls were determined every day.

3. *Results.*

From August 15, 1931 the feeding experiment with rice of different moisture content was carried out and the latent period of beri-beri and the living days of fowls were determined. The results are given in Table 1.

(See Table 1 on next page.)

From the latent period of beri-beri illness in Table 1 the comparative values of vitamin-B content in the rice of different moisture content were calculated and the following results were obtained[2].

Table 1.

Results of the Feeding Experiment with Fowls.

Moisture content of rice*		Latent period of beri-beri	Living days
at the time of harvest	at the time of feeding experiment		
10.2%	12.6%	7 days	13.7 days
11.7	13.4	6	13.3
14.1	14.7	5.7	10.7
16.1	16.0	5.3	10.0
18.3	16.1	4.6	9.7
White rice		4.3	6.0

* During the time of storage in straw bags, from June to August, the moisture content of rice changed.

If the rice of a moisture content of 10.2% at a harvest-time has vitamin-B of 100,
then the rice of a moisture content of 11.7% has vitamin-B of 71.8
„ „ „ „ „ „ „ 14.1% „ „ „ 64.1
„ „ „ „ „ „ „ 16.1% „ „ „ 48.7
and „ „ „ „ „ „ „ 18.3% „ „ „ 17.9.
respectively. It shows how the moisture content of rice has a great effect upon the preservation of vitamin-B and how greatly the content of vitamin-B decreases, when the moisture content at the harvest-time increases.

II. Influence of the Germinating Power upon the Preservation of Vitamin-B in Hulled Rice.

1. *Materials.*

The materials used in the investigation were the hulled rice of the "Asahi" and "Kibiho" varieties which were harvested in 1928. Each variety was divided into three lots with moisture content of 12%, 14% and 16%.

Each sample of a different moisture content was stored air-tight in a zinc-container. The rice with a moisture content of 12% was stored in a granary to retain as perfectly as possible its germinating power. The rice with a moisture content of 14% and 16% was stored, on the other hand, at the temperature of 35°C from March 3 to May 20 to decrease its germinating power.

2. *Method.*

The germinating experiment of rice-grains was carried out as usual. The content of vitamin-B was determined by means of young white Leghorn fowls.

Two fowls were used as a set. A few days before the experiment the fowls were fed with hulled rice. During the time of the experiment 104 g. of rice were given per kg. of body weight of fowls. Cleaned, polished rice was selected for investigation. The embryos were separated and also used in the experiment. The fowls were fed on a moisture of powdered, cleaned polished rice to each 1000 g., of which was added 1.85 g. of embryo. As control four fowls were fed exclusively with cleaned polished rice without embryos.

The feeding experiment began on July 27. The daily weight of each individual fowl and the latent period of beri-beri illness of the fowls, as well as their living days, were determined.

3. *Results.*

The germinating power of rice in May 1929 was as shown in Table 2.

Table 2.

Results of Feeding Experiments with Fowls.

Varieties	Hulled rice		Latent period of beri-beri	Life of fowls during experiment	Comparative values of vitamin-B in rice
	Moisture content	Germinating power			
Asahi	12%	100%	20.5 days	31.0 days	100
	14	0	19.5	28.5	98.8
	16	0	14.5	25.0	91.6
Kibiho	12	99.6	19.5	32.0	100
	14	0	13.5	24.0	90.2
	16	0	10.5	19.5	81.7
Cleaned polished rice only			3.5	6.5	—

As Table 2 shows, the hulled rice with a moisture content of 12% retained its germinating power perfectly, but the rice with a moisture content of 14% and 16% lost it completely.

The results of feeding fowls are given in Table 2. According to the latent period of beri-beri the authors calculated the comparative values of vitamin-B in the hulled rice as given in Table 2.

According to Table 2, the hulled rice with a moisture content of 12% had a perfect germinating power and at the same time contained more vitamin-B than that with a moisture content of 14% and 16%.

The rice with a moisture content of 14% and 16% lost its germinating power completely, but contained vitamin-B in some degree. It can not be said that, when rice lost its germinating power, its vitamin-B was lost at the same time, but

it can be said that the conditions, which caused the loss of germinating power, caused at the same time a decrease in vitamin-B content.

In the experiment under I the authors saw the following relations between germinating power and content of vitamin-B in rice.

Germinating power of hulled rice	Comparative value of vitamin-B of hulled rice
59.0%	100
49.5	71.8
21.5	64.1
7.0	48.7
0.0	17.7

Drying and cooling are necessary conditions for preserving both germinating power and vitamin-B in rice. Both a high temperature during storage and a high moisture content, on the contrary, decrease the germinating power as well as the vitamin-B content. Air-tight storage of throughly dried rice is the best method of retaining the germinating power and vitamin-B.

Summary and Conclusion.

1) In 1931, five samples of rice containing 10.2%, 11.7%, 14.1%, 16.1% and 18.3% of moisture were stored from January to May air-tight in a zinc-container, at a temperature reaching 30°C only once and then for a short time, and from June to August in straw bags; in August the rice was used for a vitamin-B experiment.

2) As experimental animals young white Leghorn fowls were used and they were fed with rice composed of 50% hulled rice under investigation and 50% of clean polished rice.

3) The results show clearly that moisture content had a great effect on the preservation of vitamin-B in rice. When the moisture content was large, the content of vitamin-B greatly decreased.

4) In 1929, the relation between the germinating power and vitamin-B content was investigated. Hulled rice was divided into three lots with moisture content of 12%, 14% and 15% and stored air-tight. The sample with a moisture content of 12% was kept at room-temperature, and those with moisture content of 14% and 16% were stored at 35°C.

5) For the vitamin-B experiment, white Leghorn fowls were used. The fowls were fed with clean polished rice to which embryos of the hulled rice in question were added.

6) From the above experiment, it was learned that hulled rice with a moisture content of 12% had a perfect germinating power in May and at the same time contained more vitamin-B than that with a moisture content of 14% and

16%. Hulled rice with moisture content of 14% and 16% lost its germinating power completely, but contained vitamin-B in some degree.

7) In conclusion it may be stated that conditions, such as high temperature during storage and high moisture content which cause the loss of germinating power, cause at the same time the decrease of vitamin-B. Air-tight storage of the throughly dried rice is the best way to retain germinating power and at the same time the vitamin-B potency.

Literature.

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